3. Subbasin Assessment – Pollutant Source Inventory

Pollutants in American Falls Subbasin originate from both point and nonpoint sources. Nonpoint sources are the largest contributors to subbasin water quality problems.

3.1 Sources of Pollutants of Concern

Point Sources

Water chemistry data from monitoring at bridges below wastewater treatment facilities (Blackfoot, Firth, and Shelley) that discharge to Snake River have indicated little measurable effect of nutrients from these sources. The amount of pollutant contributed by a wastewater treatment plant is dependent on both the plant's effluent flow and pollutant concentration in the effluent, so a high concentration of a pollutant in the effluent may not represent a significant source in the receiving water if WWTP effluent flows are low. Effluent flows at Shelley and Firth from January 2000 to September 2003 averaged less than 1 cfs (Table 2-18), while average effluent flow at Blackfoot, for the same period, was 2.45 cfs. In contrast, flows in Snake River near Blackfoot averaged 4,840 cfs (Water Years 1910-2002; Brennan et al. 2003); it is understandable why these point sources do not impact Snake River water quality to any significant degree.

Aberdeen WWTP discharges directly to Hazard Creek/Little Hole Draw, a tributary to American Falls Reservoir. Work by BOR and the Poulsons documented high nutrient levels in Hazard Creek/Little Hole Draw. Aberdeen WWTP is a source of both nitrogen and phosphorus in Hazard Creek/Little Hole Draw.

Nonpoint Sources and Pollutant Transport

Agriculture is a major source of nutrient loading in upper Snake River Basin, which includes American Falls Subbasin. Clark (1994) studied nutrients in the upper Snake River Basin, segregating sites into unaffected or minimally-affected, agriculturally-affected, or mainstem categories. He found significantly ($p<0.05$) higher concentrations of nitrite plus nitrate, total nitrogen, dissolved orthophosphate, and total phosphorus at agriculturally-affected and mainstem river stations than at unaffected river stations. Concentrations of nitrite plus nitrate, total nitrogen, and total phosphorus at agriculturally-affected stations were significantly higher than at mainstem stations. In subsequent work, Clark (1997) found significantly ($p<0.05$) lower levels of nutrients and sediment in watersheds with less than 10% agricultural land use than in watersheds where agricultural land use was greater than 10%.

DEQ (2001a) identified agriculture as the major source of nitrates in groundwater in the state. Agricultural sources (fertilizer, manure, legumes) were estimated to contribute 93% of the nitrates while septic systems and other sources were responsible for 1% and 5%, respectively.

Water quality monitoring by the Poulsons and BOR provided data used to quantify nutrient and sediment contributions to American Falls Reservoir from tributaries, drains, and springs. These waterbodies include Clear Creek, Crystal wasteway, Danielson Creek, Hazard Creek/Little Hole Draw, Seagull Bay tributary, Sterling wasteway, Spring Creek, Spring Hollow drain, and Sunbeam Creek.

A major contributor of both sediment and nutrients to American Falls Reservoir is an out-of-subbasin tributary, Portneuf River. Clark (1997) in his study of nutrients, suspended sediment, and pesticides in the upper Snake River Basin, found that concentrations of nutrients and suspended sediment were generally smaller at sites above American Falls Reservoir than at sites below the reservoir. Of the above-reservoir sites sampled, Portneuf River contained the highest levels of nutrients and sediment.

Bushnell (1969) noted two airborne sources of nutrients into the reservoir: rainfall and waterfowl feces. Rainfall can be a source of several nutrients: analysis of rain collected in gages at Pocatello Airport, Aberdeen Experiment Station, and American Falls Dam showed levels of ortho and total phosphate, ammonia, nitrate, and organic nitrogen. American Falls Reservoir is home to resident waterfowl in addition to being a major stop for migratory birds; resulting feces deposits can be a source of phosphorus to the system.

Waterfowl have been documented as a source of nutrients in lakes and reservoirs (Manny et al. 1975, Manny et al. 1994, Marion et al. 1994, Bureau of Reclamation 2001). Manny et al. (1994) estimated that an average Canada goose contributed 1.57 grams of nitrogen and 0.49 grams of phosphorus per day (based on a defecation rate of 28 times per day) to Wintergreen Lake, Michigan. For ducks, it was assumed that their nutrient contribution was proportional by body weight to that of Canada geese. From the data available, it was estimated that waterfowl annually contribute 0.85 tons of phosphorus and 2.73 tons of nitrogen (Table 3-1).

Several factors conspire to make these waterfowl nutrient loadings very coarse estimates. It was assumed that all the nutrient contribution was from off reservoir (i.e., waterfowl fed off reservoir but all defecation occurred on reservoir). The defecation rate used by Manny et al. (1994) was 28 times per day though they cited another study with a goose defecation rate of 92 times per day. Bird counts only occur twice a year and the spring count is only of nesting geese. No counts were made of other birds (e.g., gulls), which can also be a source of nutrient loading. Despite the inherent error with the estimates, the numbers were so low that until more data are available, waterfowl do not appear to be a significant source of nutrients to the reservoir.

Another source of phosphorus exists within the reservoir in the bottom sediments. Internal recycling of phosphorus occurs when low dissolved oxygen levels at the bottom of the reservoir create conditions where phosphorus attached to sediments is released into the water column.

A large amount of sediment found in American Falls Reservoir originates within the reservoir. Wind driven waves have created 20 to 40 foot high cliffs and eroded the shore by hundreds of feet (Hoag and Short 1992). The pattern of filling and drawdown in the reservoir has also contributed to shoreline instability (Young 1988). Much of the land lost was high value cropland.

Table 3-1. Waterfowl nutrient loading in American Falls Reservoir. It was assumed that nutrients were ingested off reservoir and deposited on reservoir.

Species	Status	Number of birds	Number of days present[1]	Equivalent effective goose days[2]	Mean total phosphorus/ goose/day (g)[3]	Total phosphorus load (tons/yr)	Mean total nitrogen/ goose/day (g)[3]	Total nitrogen load (tons/yr)
Geese/swans	Migrant	8,378 [4]	120	1,005,360	0.49	0.54	1.57	1.74
Ducks/coots	Migrant	10,249 [4,5]	120	522,699	0.49	0.28	1.57	0.90
Canada goose	Resident	140 [6]	365	51,100	0.49	0.03	1.57	0.09
Total						0.85		2.73

[1]migrants assumed to stay from November to February - Carl Anderson, wildlife biologist, Idaho Department of Fish and Game, personal communication

[2]calculated by dividing the average weight of dabblers (1.18 kg) and divers (1.01 kg) by average weight of Canada goose (2.56 kg) for rates of 0.46 and 0.39, respectively, times the number of days present - Manny et al. 1994

[3]from Manny et al. 1994

[4]numbers from Jan 02 & 03 counts on reservoir - Carl Anderson, wildlife biologist, Idaho Department of Fish and Game, personal communication

[5]assume half of duck/coot numbers are dabblers and half are divers

[6]numbers from annual spring count of nesting pairs of geese on reservoir 1999 to 2003 counts on reservoir - Carl Anderson, wildlife biologist, Idaho Department of Fish and Game, personal communication

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Another source of sediment in Snake River is stream bank erosion. Sampson et al. (2001) and BOR (2002) in their studies of the river between Ferry Butte and American Falls Reservoir noted extreme erosion in certain areas (e.g., Fort Hall Monument site). Although changes to Snake River in this reach have been a result of human impacts, the river's behavior in relation to these impacts has not been outside the norm.

Pollutant Sources in Bannock Creek Watershed

There are no point source dischargers located in Bannock Creek watershed. Thus, all pollutants originate from non-point sources.

A number of factors coalesce in Bannock Creek watershed resulting in excessive sediment and nutrient loading to Bannock Creek. The major land uses in the watershed are rangeland along with dryland and irrigated agriculture. Land management activities, considered nonpoint pollutant sources, caused increased loading of nutrients and sediment into Bannock Creek and its tributaries. Increased erosion of stream banks along Moonshine, Knox and Rattlesnake creeks is a chronic source of elevated levels of turbidity, deposition of fine sediment within the streambed, and the loss of habitat diversity. Stream bank stability has been degraded, primarily as a result of historic grazing practices, which have had a significant impact on the riparian vegetation and stream bank slopes. It is important to note that while West Fork Bannock Creek is listed on the 1998 303(d) list, this tributary presently displays significant water quality and habitat improvement. These improvements are directly related to the management measures (fencing of riparian corridor) that have been implemented in the subwatershed. This improvement in water and habitat quality is deemed significant enough to consider West Fork a viable target for gaging the level of improvement necessary in other 303(d) listed waterbodies within Bannock Creek watershed. Table 1-9 shows land uses of Bannock Creek watershed and its tributaries.

Based on existing data, unimproved roadways throughout Bannock Creek watershed are not considered significant sources of sediment loading. Because development of a TMDL for secondary contact recreation will be deferred until additional *E. coli* data are collected, no assessment of potential bacteria sources was conducted as part of this subbasin assessment.

3.2 Data Gaps

<u>Point Sources</u>

Monitoring by NPDES dischargers has been minimal, especially for nutrients. Additional monitoring for nutrients in the point source outfall and ambient monitoring both upstream and downstream of the source are needed. Collection of such data will improve nutrient loading estimates for the respective permit holders.

Nonpoint Sources

While the nutrient and sediment TMDLs required for Bannock Creek watershed focus only on nonpoint source pollutants (since there are no point source dischargers in the watershed), added information on nonpoint source loadings would be beneficial to better categorize nutrient and sediment loading by land use category. More data could validate the significance of unimproved roads within Bannock Creek as sources of sediment. Additional chemical, biological, and physical data collected on Bannock Creek and its tributaries would be useful to refine estimates that differentiate sediment loading contributed by the watershed from the sediment loading coming from stream reaches with poor stream bank stability. To adequately determine the spatial and temporal extent of impairment caused by sediment loading, and to refine TMDL reductions for sediments, a comprehensive approach is necessary to measure a variety of stream habitat variables. Variables to evaluate should include, but not be limited to, stream profile, instream vegetation composition, bank vegetation composition/stability, and pool:riffle ratio. The collection of additional nutrient and sediment data should also be considered to more adequately depict spatial and seasonal variation in pollutant loading, which will ultimately aid in refining pollutant reduction goals and improving the targeting and design of best management practices. Consideration should also be given to evaluating the biomass of algae affecting Bannock Creek and its tributaries as well as documentation of the limiting nutrient(s) to the algal community.

Other data gaps also warrant consideration. The source of sediment in McTucker Creek is unknown. While Knox Creek was added to the 1998 303(d) list as not supporting coldwater aquatic life use, further water quality data are necessary to identify a specific pollutant of concern. More bacteria data are required for Bannock Creek (off reservation and on reservation) to adequately assess contact recreation use. Identification and monitoring of all springs that flow into the reservoir is needed. The contribution, primarily nutrients, of springs inundated by the reservoir during high storage periods needs to be refined. The extent to which windblown sediment contributes to sediment loads in the reservoir is unknown. Another possible source of nutrient input is errant irrigation water laden with fertilizer (i.e., chemigation); the extent of this problem is not known.